MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

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WILLIAM LASSELL, Esq., President, in the Chair.

Lord Lindsay, 47 Brook Street;
Rev. J. C. Jackson, Manor Terrace, Hackney;
S. Cottam, Esq., Higher Broughton, Manchester;
T. Ribton, Esq., 48 Woburn Square;
W. H. Mahony Christie, Esq., Royal Observatory, Greenwich;
Joseph Drew, Esq., Weymouth; and
Ankitam Venkata Nursinga Row, of Vizagapatam,

were balloted for and duly elected Fellows of the Society.

Report of Observations, &c., of the Total Eclipse of the Sun, taken at "Le Maria Luisa" Vineyard, Cadiz, December 21–22, 1870, by Lord Lindsay and his Party.

Lord Lindsay writes:—

My party consisted of Lieut. Alex. B. Brown, R.A., C. Becker, Esq., Henry Davis, Esq., and myself. I also had with me three engineers, Messrs. Scott, Rogers, and Winson, the latter of whom is my laboratory assistant. Mr. Scott's services were kindly supplied to me by Mr. Browning, to whom he is chief engineer.

We arrived at Cadiz on the 4th December, and though I experienced some difficulty in getting the instruments, &c., passed through the Custom House, we got to our station on the evening of the 7th December.

The station chosen was the "Maria Luisa" Vineyard, belonging to Mr. Charles Campbell, and which, in a most kind manner, he lent to me for the occasion. My very best thanks are due to him for all he did for us during our stay in Spain.

The instruments used for observation of the eclipse were,—

1st. A 12¼-inch silver-on-glass reflector, mounted equatorially and made for an observatory in Scotland, N. lat. 57° 30′.

The complementary angle required by the change of the latitude to 36′ 41″, was obtained by a massive framework of wood made of four square pieces dovetailed and bolted through with ½-inch irons and screwed up. The base plate of the instrument stood on this frame-work, and the final adjustments were got by means of screws in the base arranged for the purpose.

The position was roughly laid down by striking the lines of shadow, when the Sun had equal altitudes, and by bisecting the angle so obtained; however, I was unable to place the telescope correctly in the meridian for several days, owing to the bad weather.

This telescope stood in a house which I took out from England for it. One end was fitted up and used for a dark room for photographic purposes. The house was 20 feet long and 11 feet deep. Of this 6 feet by 11 was devoted to the dark room: the remainder to the telescope. It was covered all over with patent felt, and doors were made to open the entire front of that part in which the telescope stood. The roof also was made to cut and slide back to give a view 5° north of the zenith.

The second large instrument was a 6-inch equatoreal by Troughton and Simms, belonging to my observatory in Lancashire. To this instrument was attached a Star-spectroscope by Browning, kindly lent me for the occasion by Mr. David Gill, F.R.A.S. This instrument was fitted with a single prism of 60°, and of moderate low dispersive power. This telescope I intrusted to Lieut. Brown, whom I wished to examine the spectrum given by the corona.

There was also an altazimuth instrument of Troughton and Simms with vertical and horizontal circles 18″ in diameter. This being a remarkably steady instrument, I used it as a transit-circle, &c.

I also mounted a 3¼-in. glass by Cooke and Sons, of York, on a wooden stand put up to the altitude of the pole.

We had very bad weather up to the time of the eclipse, in fact, the 21st was the only really fine day we had.

The morning of the 22nd was very cloudy till 8 o'clock, when it began to rain heavily, but this only lasted about thirty minutes, and then cleared up, and the Sun shone bright, though there were still heavy clouds passing at intervals over the disk. About 8 o'clock my party was augmented by the arrival of Mr. Reade, H.B.M. Consul-General of Cadiz, Mr. C. Campbell, H.B.M. Consul General of Puerto, Mr. Greaves, Navigating Lieutenant H.M.S. "Lee," Mr. Pitman of Puerto, Messrs. A. and E. Thuillier, and Señors Lassaletta and Gonzales.

Mr. Reade and Mr. Campbell and Señor Brogi undertook to assist Lieut. Brown at the spectroscope, while Mr. Pitman kept the time for me. Mr. Greaves measured the angular distance of the streamers of the corona and also the chief prominences

from the vertex of the Sun as seen in an inverting telescope. These angles were recorded at the time on a position-circle attached to the telescope. The Messrs. Thuillier and Señors Lassaletta and Gonzales made eye-sketches of the corona. These, when compared with the measurements of Mr. Greaves, show a good deal of correspondence *inter se*, though at first sight they might appear to differ.

The first contact was observed by Lieut. Brown with the 6-inch equatoreal, and also by myself with the 3-inch. This occurred at $22^h\ 50^m\ 3^s{\cdot}5$, G.M.T., or in local time, $22^h\ 24^m\ 59^s{\cdot}7$.

I secured several plates during the partial phase of the eclipse, but I was prevented from taking as many as I wished by the stop of my instantaneous slide giving way from the concussion, owing to the strength of the spring. Everything was ready as totality drew near, and the last minute was one of intense anxiety. The time observed of the commencement was $0^h\ 14^m\ 52^s{\cdot}50$, G.M.T., local time, $23^h\ 49^m\ 48^s{\cdot}7$.

During totality I had assisting me at the 12¼-inch equatoreal Mr. Scott, to watch through the finder that the telescope did not shift from its position while changing the plates. Mr. Rogers took the plates from the dumb-waiter, up the partition of the dark room, and handed each fresh one to me and put back the last exposed plate. Mr. Davis and Mr. Winson were in the dark room; the latter coated the plates and put them into the baths, while Mr. Davis received the exposed plates developed, and placed them in a fixing trough.

I had several times previously gone through the drill of totality, so that we all knew our work and about the number of plates we could run through in the time, and I had found that allowing rather short exposures, I could generally put twelve to fourteen plates through the camera in $2^m\ 10^s$. I did not, however calculate on getting as many as that, for fear of under-exposing them.

The last plate of totality was lost by my not pulling the slide open quick enough, as I missed the knob to catch it by, and when I had got it open totality ended.

This picture was developed, but not a sign was to be seen on it. In fact, as soon as I opened the slide I closed it again in hopes that I might have got a picture just as the Moon began to leave the Sun, but I must have miscalculated my exposure, as certainly if I had done this there must have been an impression on the film. I think, therefore, the exposure must have been over about $0^s{\cdot}5$ before the totality ceased.

The time was taken as the first glimpse of sunshine reappeared, and is in G.M.T., $0^h\ 17^m\ 0^s{\cdot}5$, local time, $11^h\ 1^m\ 19^s{\cdot}7$, which gives a duration for the total phase of $2^m\ 8^s$.

Immediately after totality I replaced the instantaneous slide which had been removed during totality; but I was not fated to get another picture, as while the camera was being altered, a dense rain-cloud came up rapidly and entirely obscured the Sun,

and although I made several attempts they were quite unsuccessful. In fact, we did not get a glimpse of the Sun again the whole day, as it set behind the same cloud.

I then went round and collected the various reports from the rest of my party. Four gentlemen had been successful in getting sketches of the corona and some of the prominences.

I will now pass to the general observations made before and during totality.

At 11.40, local time, the sky was of a purple tint, earth red-brown; everything green seemed intensified in colour.

At 11.45, a strange colour came over the landscape, dark and yet distinct, persons looked livid, cumulo-stratus below the Sun.

At 11.47, objects attained a yellow tint, which decreased in ntensity, and white with a red blue shade.

At 11.48, the clouds seemed to open out all round the Sun.

At the moment of totality the corona shot out on all sides of the Sun, and presented a most wonderful sight. The clouds in the north-east were purple; south-west, blue; north, grey.

Mr. A. Thuillier reports that, during totality, a flock of geese came towards him as if for protection, and the fowls all huddled up in a corner of the roosting-place, as if they were frightened.

I saw *Venus* plainly to the east of the Sun, and fancied that I saw another star, but cannot be sure.

I had requested all my party to notice particularly if the shadow of the Moon was to be seen advancing through the air, but none of them saw it.

The following is a Report by Lieut. Brown of his observations taken at Maria Luisa Observatory, between the 9th and 23rd of December, 1870, including the total eclipse of the Sun on the 22nd.

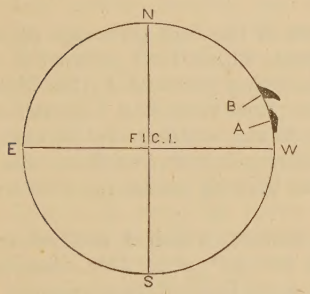
The general weather notes, also thermometric and barometric observations taken daily, I hand in as a separate form to accompany this paper.

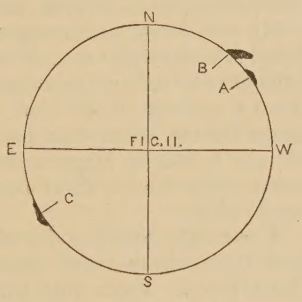
The instruments placed at my disposal were, 1st, a 6-inch equatoreal of 7-feet focus, moved by clock-work, made by Troughton and Simms. 2nd. A star-spectroscope, fitted with a single equilateral prism of very dense glass, very well adapted for spectroscopic analysis of the corona (or of the prominences during totality) made by Browning, of London. This instrument needed only to make it complete for its purpose, to have an automatic recording arrangement affixed thereto. I hardly realised the necessity for this till within a few days of the eclipse, so at once set to work to construct a recorder, and fitted it to the spectroscope, which, as will be hereafter seen, worked very well. Indeed, I know of no other mode of measuring the position of lines quickly that I would adopt during an eclipse. Any attempt to read off the position of the cross-wires in a graduated arc *several times* would be quite out of question, and any species of comparison references I should

equally reject as being confusing and untrustworthy, besides being very liable to derangement.

Every available observing day and night between the 10th and 22nd, the 6-inch equatoreal was called into use for various duties, transits, occultations, mapping of Sun-spots, spectroscopic observations (with the assistance of the spectroscope) on the spectrum of the Sun at different altitudes, of the Moon at different ages, and of *Jupiter*, and of one or two of the fixed stars; also of some of the solar prominences.

I made several successful, and I believe pretty accurate maps of the Sun's spots between the 11th and 22nd, one of which (B) shows fairly, and another (A) well, patches of faculæ. The four most successful maps were taken on the 13th, 18th, 21st, and 22nd, the last corrected up to the time of occultation of the spots by the Moon. These four accompany this Report, the others being less reliable, owing to unfavourable atmospheric influences, &c., I have thought unnecessary to preserve. The maps were made by the assistance of the 6-inch equatoreal, with powers of 31 and 65.





I had several opportunities of examining the prominences projecting from the edge of the disk of the Sun, but the most favourable occurred on the 20th and 21st instant. On the 20th I detected two prominences nearly joining, situated at A and B, Fig. 1, of which B was the largest and manifested a disturbed condition, it gave lines C; another (C′) rather more refrangible than C; one near D and F.

On the 21st I noticed B again, the action being more violent, and by examining it in different positions of the slit of the spectroscope I believe it to be tongue-shaped, as shown in Fig. 2, and estimated its height about 30,000 miles; it then gave lines as before, to which were added another near D and one less refrangible than F; they were of varied heights and continually altering in intensity.

The prominence A was smaller than the day before, but another prominence (C) was observed on the opposite limb of the

Sun more extensive, but not so high, giving line C (near), D (near), and F of different heights.

On the morning of the 22nd of December, the day of the total eclipse of the Sun, I carefully noted as usual the barometric, thermometric, wind, and weather readings at 9 A.M., which were

Barometer, 29·78, and falling.
Thermometer (in shade), 55° F.
Wind, W.; Force, 2½–3.
Weather, cloudy and overcast.

At $20^h\ 24^m$ (Greenwich time) the Sun shone out for a few minutes, the wind lightened and came round a little towards south, and we were cheered with the anticipation of a fair day. There arrived at this time Mr. Reade, Consul-General of Cadiz, Mr. Campbell, Consul of Puerto St. Maria, and Señor Giuseppe Brogi, who undertook to assist me in the spectroscopic and any time general observations I might require. These gentlemen were furnished with the necessary forms to fill up and instructions for observations, time-records, &c.

My first work, as the appearance of the Sun gave me opportunity, was carefully to map the spots, which were corrected up to the time of the the principal ones being occulted by the Moon. About a quarter of an hour before first contact a considerable change for the better was manifest in the weather, the patches of blue sky becoming larger and remaining longer free from clouds, though even then a faint haze was blowing across the Sun from time to time.

I carefully watched for first contact, which I noticed took place (Greenwich mean time) at $22^h\ 50^m\ 3^s{\cdot}50$ (Mr. Campbell taking time). From this time a more decided improvement in the state of the sky took place, and all my party were enabled to observe the Sun from time to time through my telescope.

At first contact I did not observe anything like spots of light on the Moon's limb or rugged semi-illuminated projections: it had the appearance of a circular disk with a smooth edge ; the darkness of the Moon was equal to that of the surrounding sky; I could then notice no difference. Some time after, however, the jagged outline of the Moon was marked on the Sun. At the occultation of the spots the Moon appeared darker than any portion of the spots, which were then very clearly seen. After this occultation I fitted and adjusted my spectroscope, and carefully recorded the position of the solar lines C, D, E, b, F, G, h, both above and below the spaces left for corona and prominence observations by means of my automatic recording arrangement.

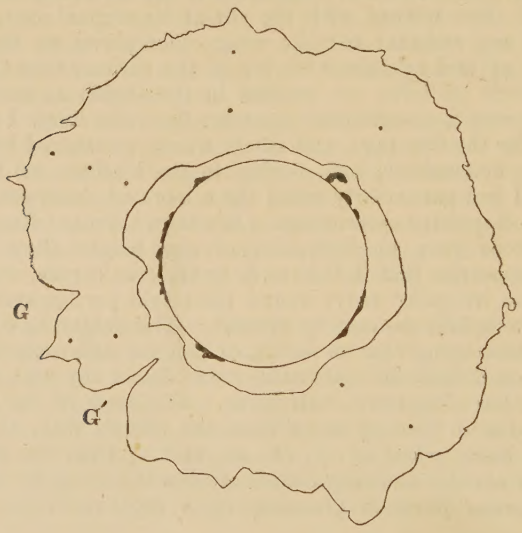
About ten minutes before totality Señor Brogi placed the cross-wires of my finder in the eastern limb of the Sun, and followed its motion, while I searched in vain for prominences which appeared so brightly shortly after; this was probably due to the haze which

more or less obscured the Sun at that time. This haze, however, blew over during the last ten seconds before totality, and the thin crescent of the Sun on my cross-wires enabled me to adjust my slit accurately at the last moment; the exceeding rapid disappearance of this luminous crescent in my spectrum (which disappeared from a decided measurable breadth), which now appeared almost dark, manifested to me that the long-expected moment had arrived; to my call time Mr. Campbell promptly replied, $0^h\ 14^m\ 52^s{\cdot}50$ (Greenwich time). I immediately directed my assistant to place the cross-wires of the finder on a portion of the corona about 8′ or 9′ from the obscured disk of the Sun, when I at once got a *continuous spectrum* about equal in intensity to that given by the Moon just before entering its third quarter, free from any lines bright or dark. I then tried to shut off the light *partially* by decreasing my aperture, my spectrum faded, still I got no lines. I opened it more than before, no appreciable alteration in the colour or brightness of my spectrum, but still no lines. I then worked with the slit at its original aperture, and directed my assistant to take some other places on the corona between 4½′ and 25′ (about the top of the corona) from the Sun's disk (which positions are marked in the sketch as black dots), the same result, a continuous spectrum free from lines. I searched in vain for the line 1474, and others whose positions I had before carefully determined; and, thanks to the kindness of Professor Young, I had particularly noted the celebrated American line in his high dispersive spectroscope a few days before at Xerez. My spectroscope gave no indication of any bright lines on that luminous portion that I believe to be the true corona, and which formed an irregular curve round the bright portion surrounding the chromosphere (as seen by sketch). This might be due to the fact of there being none to notice, or that the unfavourable atmospheric conditions did not enable me to detect any with my comparative low dispersive instrument. The parts of the corona I examined were from 4½′ to 25′ from the Moon's disk, the actual position being about 4½′, 7′, 12′, 20′, and 25′ from the Moon. I carefully avoided thus any chance of error in mixing up an achromatic chromosphere or prominences in my examination of the Corona.

During totality I wished to see if my assistant at the finder was following my directions, and so requesting him to stand on one side for a few seconds went myself to the finder, and saw the cross-wires on the part of the corona I wished to examine. For some ten or fifteen seconds I gazed at the dark orb surrounded by its glorious corona; and then I was struck by three prominences which appeared to me the largest of several on the disk, A, B, C, of which B was tongue-shaped. I then remembered my instructions to some of our party using telescopes and observing with the eye alone, for they were on the exact positions, and B also of the exact form I had predicted, from having noticed them in the spectroscope the day before. I was determined at once to

test their constitution, to see if they would give the same lines as I had before observed without an eclipse.

I have endeavoured to make a rough sketch of the picture* presented to me in the telescope and by the eye ; one remarkable part of which was the difference I noticed the corona to have near the Sun, it seemed to me distinct from the rest of the corona, and to be irregular in outline, bulging out or extending much further from the Sun in some places, whereas in others it took the form of concentricity with the Sun; it had, moreover, the colour and appearance of pearl, with a bright phosphorescent tone about it, and was similar and dense throughout, whereas the rest of the corona had a faint violet colour, tinged in places with faint green and faint yellowish red, and decreasing in luminosity as its distance from the Sun increased; moreover it was jagged somewhat in outline and had gaps in it (as seen in sketch), and very faint striations might be seen in it ; the inner portion, as I



have said, was quite different; and I should consider it an achromatic chromosphere surrounding the regular chromosphere, and separating it from the corona. I would venture to suggest the name of Leucosphere for it, in contra-distinction both to Chromosphere and corona. I consider it to partake more of the character of the former, the latter (Corona) I believe to be solar, while the variations in colour and faint streamers may be partially due to the passage of light from less luminous portions through our atmosphere.

* The woodcut is merely an outline from a finished coloured drawing of the Corona sent by Lieut. Brown.—*Ed.*

To return, however, to the prominences, many of which were bright red (and could easily be seen by the naked eye), while others were pink and several more or less tinged with violet at the upper edges. (I have endeavoured to sketch them in my drawing which in rough outline was made immediately after totality.)

I directed my cross-wires to be placed on the prominence B, and immediately got the line as follows :—

	Name of Line.	Prominence B. Angular Value.	Tongue-shaped. Reduced to Kirchhoff Scale.
	C	109° 38′	695
(more refrangible than C)	C′	109 41	730
near	D	110 4½	1015
(less refrangible than E)	E	110 43	1470
	b	110 56¼	1635
	F	111 33⅓	2080
	h	113 20¾	3370

The heights of these lines were different, and violent action was manifested, especially in the lines C, F, *h* ; the heights I was unable to measure, but have entered as carefully as I could judge with the eye; the greatest height of the prominence seemed to be 2¼′, it was bent, and near top was less red in colour, tinged with bluish violet ; its estimated height was 55,000 miles.

The prominence A gave six lines ; the positions were not recorded, but I believe them to be at C, two nearer D, one near E (which seemed to be in a position midway between the E mentioned above and the true E), one either a little less refrangible than C or identical with it ; these lines were all shorter than those in B, one near E being the highest ; they underwent less change. I did not have time to mark on my recorder their position, being anxious to pass on to the examination of C on my scale.

Prominence C.

Name of Line.			Angles.	Reduced to Kirchhoff Scale.
	C		109° 38′	695
(near)	D		110 4⅓	1015
(near)	E	less refrangible	110 43¼	1475
	F		111 33⅓	2080
(near)	G	(probably G)	112 37½	2850

The lines C, E and G were the highest, E being the highest of the three ; then came G as a broken flickering line, part being seen bright near top and at bottom with variable brightness in

the intermediate part. There seemed to be a short line near *b*, and another short one more refrangible than G, which I could not mark as the dark disk of the Moon seemed to be rapidly covering the prominence. I devoted the rest of the time to a further examination of the corona with the same result as before. I also directed my cross-wires to be placed on the gap (marked G in figure), and then the spectrum gave no lines, but almost entirely faded away, even upon further opening the slit; the green and blue portions seemed to be comparatively brighter with respect to the red end than before.

As totality was nearly ended I directed Señor Brogi to take up a position on the advancing limb of the obscured Sun, when, after watching for three or four seconds, a thin crescent of light illuminated my spectrum, growing suddenly broad and bright, and showing the dark solar lines distinctly, giving me conclusive proof that totality was ended. I at once called time and was given $0^h\ 17^m\ 0^s{\cdot}50$, making the length of our observed totality just $2^m\ 8^s$.

With respect to the measurement of the lines in the prominences, I have endeavoured as accurately as possible to get the angular value, and from my marker believe I am correct to half a minute, but at any rate I cannot be ten divisions out on any line, taking the position of C on Kirchhoff's scale to be 695.

I will close this Report by adding the few remarks made by my assistants and handed to me.

Mr. Reade states, "At 12 minutes after noon darkness especially came on. Everything terrestrial had a leaden hue, while clouds assumed a purple colour; grass, however, was beautifully green. I saw a star or planet near the Sun (probably *Venus*)."

Mr. Campbell writes, "A cloudy day; as totality approached darkness rapidly came on. I had no need of the lamps for recording time and general observations by. I looked for a dark shadow to approach at time of totality, according to your directions, but saw none."

Senor Brogi says, "At the moment of totality, the Sun and Moon seemed to run together like one wheel running inside another in opposite directions; then immediately the corona appeared, and did not appear to fade away till after totality was ended; there was a haze blowing over the Sun part of the time."

I should add, amongst my own remarks, that, at $22^h\ 46^m$ G.M.T. a strong squall, with rain, lasting some five minutes, came on, and during totality the wind was measuring in force about 4; that darkness came on about ten minutes before totality, and the grass began to appear greener; that, during all this period, and indeed till totality, the sky and Moon appeared to me of equal darkness, but during totality the disk of the Moon was darker than the sky considerably. This might have been

the effect partly of contrast, surrounded as the Moon was by the Leucosphere, and the corona encircling that. The edge of the corona most distant from the Moon seemed to fade in most places almost insensibly away, except where clouds gave it a more abrupt edge. They seemed to cut off some light at the edges. Doubtless, darkness during totality was less by reason of the diffused light scattered by the clouds. The amount of illumination was about equal to that given by the full Moon when a faint haze is blowing over, but of a different character.

We required no lamps for recording or reading by. The light was sufficient without. Some of the highest clouds at some 3° or more apparently from the Moon, seemed to be more illuminated by the light of the corona, Leucosphere, and prominences than those in other places.

At the moment of totality a feeling of loneliness and sadness seemed to come over one, and I could distinctly hear the subdued murmur of voices close at hand while the reappearance of the Sun seemed to bring a feeling of relief.

A few moments after totality was ended clouds blew over and the sky looked threatening. The Sun appeared for a few seconds only about a quarter of an hour after, and then disappeared for the rest of the day; heavy clouds blew up, and the wind rose, blowing at times gusts of 10 from the W.S.W. direction, with heavy rain. All this time, and in fact during the day, the barometer was falling: it read at A.M. 29·78, at 3 P.M. 29·61, and at 5 P.M. 29·55, still falling. Every effort to obtain last contact failed, and at 4 P.M. our flag, the British Ensign of the Blue, which had marked the Maria Luisa Observatory in the distance from the surrounding abodes, fell with its shattered staff. The elements seemed to say, We have up to the present held ourselves in check for your pleasure and for the success of your observations, and now that these are satisfactorily accomplished, we will have full play for our bottled-up energies.

Mr. Becker as to the Polarimeter observations reports as follows:—

The Polarimeter consisted of a Nicol prism in connection with a Savarts' band prism, attached to a box containing four glass slides, which can be turned so as to form different angles to the prisms.

The sky being covered nearly the whole morning, the preliminary observations of taking the sky polarization at certain intervals could not be taken, although the progress of observation could be well followed. As the time of totality approached, the sky brightened sufficiently in the neighbourhood of the Sun to see the totality with sufficient clearness. When totality was nearly complete, and directly after it was over, the polarimeter was directed towards the Sun, and not a trace of polarization was visible. At the time of totality the polarization appeared, the middle band being white, and was too intense to be thrown out

by turning the plates. By inclining the instrument to an angle of 23° to the west the bands disappeared. No difference could be observed between the Moon's disk and the corona. The polarimeter not being of a construction to localise a beam of light sufficiently.

General Remarks.

Protuberances were observed in three different places more in a cloudy form, as in the shape of horns at great prominences. Just before totality the whole sky had a leaden appearance. At the time of totality the blue patches in the sky appeared of a very deep purple colour, contrasting much with the rich brown appearance of the clouds.

The northern end of the crescent appeared like a string of pearls just before it was covered by the Moon.

On the Solar Eclipse of December 22, 1870, observed at Xerez in Spain. By R. Abbay, Esq.

The instrument with which my observations of the eclipse were made was a chemical spectroscope of two prisms of 45° each, kindly lent to me by Prof. C. A. Young, of Dartmouth, U.S. The diameters of the lenses of the collimator and telescope were $2\frac{1}{4}$-inches each, and the focal lengths about 17 inches. The slit was about $\frac{1}{8}$-inch in length (nearly one-half of it being covered by the prism used for reflecting the light from the vacuum tube into the collimator) and was placed in a horizontal position. There was a horizontal and vertical motion of the whole instrument, so that the collimator could be kept on the Sun without difficulty for almost any length of time. The angle of aperture of the collimator was about 7°, so that when directed to the Sun the light passing through the prisms was composed of that proceeding from all points within an angular radius of $3\frac{1}{2}°$ from the Sun's centre, including, therefore, prominences, corona, and a portion of the sky surrounding them. A short time before totality began, I arranged the slit so that the D lines just appeared as a single thick line, this being the narrowest slit which it seemed safe to attempt to use, though I had determined to narrow the slit considerably if the bright lines appeared as bands on a continuous spectrum.

At 11.44, Xerez time, I noticed the B line extremely black. As totality approached the dark Fraunhofer lines slowly disappeared, leaving a dull spectrum, which also faded away immediately before three bright lines C D F (identified by means of the vacuum tube) made their appearance. These three lines came into view within two or three seconds after the shout announced that totality had begun, and they remained about 8 or 10 seconds.

C and D then disappeared, and two very sharp bright lines were seen, one coincident with the bright F line given by the vacuum tube, the other less refrangible than *b*. After some trouble I succeeded in placing the cross-wires very nearly on this bright line, and determined not to move the telescope during the rest of totality. No other lines appeared, although the C line of the vacuum tube was in the field on the one side and the F line on the other. I saw no continuous spectrum—the lines were bright on a dark ground. The F line was a little less bright than the other. On the reappearance of the dark lines after totality, I found that the cross-wires were on the vacant space between the lines 1464 and 1494 of Kirchhoff's scale. The measurement was as accurate as it was possible to obtain with the instrument used, and I cannot say with certainty that the bright line seen was absolutely coincident with the 1474 line. In order to give an idea of the dispersive power of the prisms, I may mention that after totality I tested the instrument by means of the light of the dull, heavy clouds which obscured everything, and found that I could not separate the D lines, but was able to obtain four thick lines like bands between E and *b*. I also saw 1464 and 1494 as single thick lines. By a rough calculation from the number of threads of the screw and the distance through which it was turned in bringing the jaws of the slit into contact, I came to the conclusion that it was from $\frac{1}{250}$-in. to $\frac{1}{200}$-in. wide. At the end of totality I noticed no reappearance of the bright lines C and D, nor do I remember at what moment the continuous spectrum came again into view. At about the middle of totality I looked up for a second or two at the corona; it appeared to the unaided eye to be distinctly and unevenly radiated. The light was of a pearly white, apparently of about the intensity of the full Moon, and extended to a distance of half or two-thirds of the diameter from the Sun. The shadows cast by certain parts of my instrument seemed as deep as those of a bright moonlight night, and the ivory handle of my commutator, which happened to be in shadow, was difficult to find.

The gradual disappearance of the Fraunhofer's lines as totality approached admits of two explanations. Either it was due to the general weakening of the light making it impossible to perceive these lines, or it was due to the superposition, on the spectrum with dark lines produced by the general light of the sky in the neighbourhood of the Sun, of a spectrum consisting mainly of bright lines proceeding from the extreme edge of the Sun's limb, this causing the Fraunhofer's lines to be more or less obliterated.

From the disappearance of the bright lines C and D some eight or ten seconds after the beginning of totality, I inferred that until the instant of their disappearance the chief part of the light passing through the prisms was due to the semicircle of the chromosphere, together with the prominences, visible chiefly on one limb. After this, and during the central period of totality, the main portion of the light was given by that part of the envelope

of the Sun which is above the red flames (whether chromosphere or corona). It is possible the green line, which was the stronger, may be due to some substance in the highest portion of this envelope; and the F line, which continued during the whole of totality, to moderately cool hydrogen somewhat nearer to the Sun's surface. It is clear that the same spectrum will be obtained, during the middle of totality, from light proceeding from points anywhere apparently in the neighbourhood of the Sun, and even from that reflected from clouds, as the whole atmosphere is then illuminated by light of this peculiar kind, so that the spectroscope does not appear to me capable of giving any conclusive evidence as to the extent of this luminous envelope.

Oxford, Jan. 13th, 1871.

Solar Eclipse, Dec. 22, 1870. By William Stainer, Navigating Sub.-Lieut. H.M. Gunboat Pigeon.

Went on shore to visit the astronomers, and was fortunate enough to observe the eclipse of the Sun during its totality with a $2\frac{1}{4}$-inch inverting telescope belonging to Mr. James Buckingham, C.E. I distinctly saw a rim of light around the dark body of the Sun, extending to about $\frac{1}{30}$th of the Sun's diameter from the edge. I also saw three permanent shoots of light extending about $\frac{1}{10}$th of the Sun's diameter from the Sun's edge; one on the N.E., one on the S.E., and one on the S.W., besides several smaller ones between, they were reddish, close to the edge, and yellowish towards the extremity. The diameter of the rays of light was about $\frac{1}{3}$rd of their length; the interval that elapsed during the visibility of the corona was from five to ten seconds. *Saturn* I also observed distinctly below the Sun at a distance of twice its diameter. The telescope through which I made the observations was the finder of Mr. James Buckingham's large 9-inch telescope for photographing the corona; the Sun being kept directly on the cross-wires of the telescope by clockwork.

The Spanish observers, including the Astronomer Royal of Madrid, who were about a mile distant, saw nothing whatever of the corona during the Sun's totality, which at this place was $2^m\ 9^s$.

Solar Eclipse, December 22, 1870, *observed at San Antonio, near Puerto de Sta. Maria.* By the Rev. S. J. Perry.

Being prevented by a course of lectures, and by pressing observatory work, from attending the January meeting of the

R. A. S., I think I shall best conform to the desires of the Fellows of the Society, by bringing under their notice a few short notes on some of the more salient points connected with our late observations of the total eclipse.

1. Form of the Corona. Approximately quadrilateral; outline not very well defined. Greatest in extent over the two sets of red prominences; in the north-west quadrant it was discernible to a distance of about seven-eighths of the lunar diameter. No streamers or curves, but only a glow of light fading off, as it receded from the Sun; this uniform appearance was, however, broken by four or five slight darker gaps radial to the limb. The streamers seen at Lord Lindsay's station, where the sky was clear, were perhaps too delicate in structure to be visible through our clouds of cirrus. Further evidence seems required to establish the fact, that even these streamers are due to our atmosphere.

2. Within the Corona, but surrounding the chromosphere, is a narrow band of silvery white, whose width is about one-tenth of the solar diameter. The intensity of the light appeared to be uniform throughout this band, whereas it faded off in the corona as it got further from the Sun.

3. Duration of the Corona. I did not see the corona before totality commenced, as I was wholly engaged with my spectroscope; but from notes taken for me by Lieut. P. H. Worgan, of H.M.S. "Lee," I find that the end of totality was observed at $12^h\ 17^m\ 12^s$, G.M.T., and the disappearance of the corona at $12^h\ 17^m\ 52^s$. This interval is, I think, too long by a few seconds, but it could scarcely have been less than 35^s. This phenomenon was very striking, easy of observation, and quite unexpected at the moment.

4. Nature of the Corona. My own spectroscopic observations are merely negative, no bright or dark lines, with possibly a faint glimmer; but these observations, continued on different parts of the corona during about two-thirds of totality, are of little weight, as the light of the corona, rendered exceedingly feeble by the intervening cirro-stratus, could not be expected to penetrate through my three compound prisms. The bright lines seen on the dark body of the Moon by Capt. Maclear, R.N., show that we must receive with great caution any observations of bright lines in the corona, which are coincident with those of the chromosphere, especially when the bright lines of the prominences are dispersed by intervening clouds and atmosphere.

These remarks refer merely to my own personal impressions. The position of the place of observation is

Lat.	36° 37′ 13″, N.
Long.	$24^m\ 45^s$, West of Greenwich.

Solar Eclipse, Dec. 22, 1870. By C. G. Talmage.

We arrived at Gibraltar on the evening of Tuesday, December 13, it being late, we did not land until the following morning; Capt. Parsons and myself took up our residence at the Club-House Hotel. Our first wish was to fix on a good site for our observing station, and with this object in view, we consulted several old inhabitants, and after going round the Rock twice, we determined on making an old tower, belonging to the Moorish castle, our post. At the top of the tower there is a solid square terrace, at an elevation of about 300 feet above the sea-level, we found that this position was much below the mist and cloud line, the higher parts of the Rock being subject to frequent enshroudings in mist and cloud.

Wednesday, the day before the eclipse, was beautifully clear with a north-west wind, which generally lasts three days at Gibraltar; we went to bed with great hopes of a fine day on the morrow, but the wind unfortunately changed to the south-west during the night; and at sunrise a heavy bank of clouds rose in the west, and gradually got higher, so that, by nine o'clock, the sky was quite covered.

I proceeded to the Moorish castle at $9^h\ 15^m$, leaving Capt. Parsons on the line wall, as there seemed no chance of one place being better than another, or rather all seemed equally bad, so thick and threatening were the clouds, and by this time every part of the Rock was cloudy, as we were informed by telegrams, which Capt. Parsons had arranged to have sent to him half-hourly.

I was not able to see the first contact, but had glimpses of the Sun soon after; rain then fell for a short time, and again the clouds were a little thinner, the clearest time being from $60''$ to $5''$ before totality, when the clouds suddenly heaped up and completely obscured the Sun.

The time of totality was evident from the darkness, which was greater than I had anticipated. As there was no chance of seeing *Saturn* I glanced round, over the landscape, which was very striking, a thrill of horror seemed to run through one. I saw the lights in the town below distinctly, and to my right (nearly west) I saw the fires burning in the cork woods behind Algeciras, about twelve miles distant. The noise made by the people on the Old Mole was suddenly hushed during totality, and revived with increased vigour after. The clouds got thinner a little after totality, and cleared off sufficiently to allow of my observing the time of last contact.

Work done at the Kew Observatory.

(*Communicated by Warren De La Rue.*)

Pictures of the Solar Eclipse were obtained at the Kew Observatory by means of the Photoheliograph at the following times:—

Dec. 22, 1870.

	h	m	s
(1)	1	7	12·5
(2)	1	12	26·5
(3)	1	17	55
(4)	1	28	29·5
(5)	1	33	21·5

Of the above only Nos. 1, 2, and 5 are capable of being printed to advantage. Had the weather proved favourable a large number of photographs would have been procured.

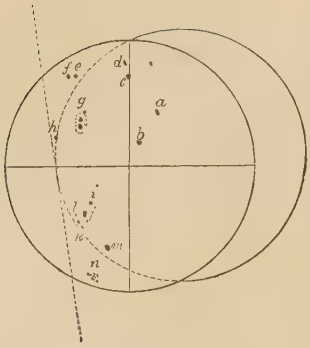
Solar Eclipse, December 22, 1870. By John Joynson, Esq.

First contact of limbs $11^h\ 4^m\ 19^{s}{\cdot}1$ A.M. G.M.T.
Last contact of limbs $1\ 35\ 55^{s}{\cdot}2$ P.M. „

Lens 3½-in. Inverting Eye-piece. Power 60.

The eclipse was seen under the most favourable conditions that could be desired at such a late period of the year. The sky was entirely free from cloud while the eclipse lasted; save at about $1^h\ 15^m$ P.M., when a few streaky clouds passed over the Sun; but which did not in any way interfere with the observations. The weather was exceedingly cold, the thermometer being about 36° even in the Sun's rays, and in the shade there was hard frost all day.

The observation of the first contact of limbs agrees to seven seconds with the calculated time for this place; and that for the last contact to two seconds. This no doubt arises from the fact that the last contact of limbs is always more easy to observe exactly than the first, as the limbs may be in actual contact before the time noted.



On the Sun's disk there were a considerable number of spots. The times of disappearance or of reappearance were taken for most of them; and in several cases they were observed both for disappearance and reappearance.

The position of the spots on the diagram must only be considered approximate; being merely eye estimates of their places just before the commencement of the eclipse. The times given are believed to be as exact as such observations will permit.

		D.	R.
		h m s	h m s
a	...	11 16 13	12 32 9
b	...	11 33 54	11 50 29
c	...	...	12 25 4
d	...	...	12 21 54
e	...	...	12 15 39
f	...	...	12 11 45
g	Spot, Upper	11 29 50	12 26 59
	Middle	11 31 4	12 29 19
	Lower	11 36 20	12 31 44
	Penumb.	11 30 19	
h	...	11 51 39	12 16 50
i	...	...	12 55 24
j	...	12 7 4	
k	...	12 13 48	
l	...	12 13 39	12 55 41
m	...	12 15 31	
n	...	12 24 19	

In reference to the spots the only remark seemed to be called for was that the two largest in the N.W. quadrant had very much the appearance of a dumb-bell; being connected together by a series of small black spots in a line between them, and having a wavy line enclosing the whole, as if the enclosed space *had* been one spot. These small black spots between the large ones visibly lessened in size while they were hidden by the Moon.

Very little was seen here of the eclipse of the Moon on the 6th inst., owing to dense cloud, which did not break until it was nearly over.

Waterloo, near Liverpool,
11th January, 1871.

The Solar Eclipse of December 22, 1870. By C. L. Prince, Esq.

The early morning of Dec. 22 was very cold, the sky completely overcast, and a few flakes of snow fell occasionally. The minimum temperature of the air had been 23°·2, and that of terrestrial radiation 18°. Wind N.E., and for several hours preceding the eclipse the horizontal movement of the air had been 18 miles an hour. The barometric reading from 9 A.M. till 2 P.M. remained almost stationary at 29·936. Soon after 9 o'clock the large masses of composite cloud began to break and disperse. At 10 o'clock the Sun shone brightly, and by half-past ten the southern portion of the sky became almost cloudless, and so continued till after the termination of the eclipse. I was, therefore, fortunate enough to have an uninterrupted view of the phenomenon as seen in this latitude. There were two conspicuous spots on the N.W. portion of the Sun, and many smaller ones scattered over its surface. The definition was better than might have been expected with such a brisk current of wind blowing from the N.E.

Shortly before the commencement of the eclipse some thin cirrostrati, which were drifting with a S.E. current, at a great elevation, exhibited very beautiful prismatic colours. At this time the temperature of the air at 4½ feet from the ground was 24°·6; at noon it was 24°·2; and at 2 P.M. 26°, which was the maximum for the day.

	L.M.T. h m s
The first contact occurred at	11 8 48
Preceding spot, of two, occulted, both Umbra and Penumbra	11 35 53
Following spot, of two, occulted	11 42 33
Emersion of preceding spot	0 37 58
,, following spot	0 40 40
Last contact	1 42 42
Magnitude of the Eclipse, as nearly as I could ascertain	0·820

At the time of greatest obscuration, a very *sensible diminution* of daylight was perceptible, and a peculiar yellowish golden light tinted all the trees and shrubs close at hand. The Moon appeared intensely black while passing over the Sun's disk, and it was interesting to observe how much darker the limb was than either the umbra or the actual nucleus of any spot. I particularly noticed that the penumbra of each was well defined to the instant of occultation. The inequalities both of the preceding and following limb of the Moon were very trifling as compared with those which I saw during the eclipse of March 1867. For the observation of this eclipse I employed my Tulley Equatoreal of 6·8 inches aperture and 12 feet focal length. Power 140. My Observatory is 24″ East of Greenwich.

Uckfield, January 3, 1871.

Solar Eclipse of December 22nd, 1870.

By J. B. Dancer, F.R.A.S.

Lat. 53° 28′ 21″·75 ; Long. $0^h\ 8^m\ 52^s{\cdot}47$ W.

The eclipse of the Sun, on Thursday, the 22nd of December, was favourably observed here. Although a slight haze prevailed, all the details of the phenomenon were distinct, and tolerably well defined.

A number of spots were visible on the Sun's surface, two of which were of some magnitude. The nuclei of these spots were linked together by maculæ, and surrounded by a penumbra which extended to a considerable distance. Faculæ also were very numerous and distinct.

The times of contact taken by a chronometer carefully corrected to Greenwich mean time were as follows:—

	h	m	s
First contact of the Moon's Limb with the Sun ..	11	5	49
Contact of Moon's Limb with nucleus of the first large spot	11	31	36
With the nucleus of the second large spot	11	37	20
Last contact of Moon's Limb with the Sun	1	37	3

The temperature during the progress of the eclipse was taken at intervals by a mercurial thermometer with a black bulb in vacuo, exposed to the Sun at the height of 4 feet from the ground.

Time.	Temperature.	Time.	Temperature.
h m s	°	h m s	°
11 10 0	31·5	12 22 0	27·2
35 0	30·25	35 0	28·5
45 0	29·75	1 37 0	29·0
50 0	29·25		

By reference to the table of temperature it will be seen that at the time of the greatest phase the temperature was 4°·3 lower than at the commencement, and that the thermometer had risen 1°·8 at the time of last contact. A thin covering of snow was on the ground at the time.

I had an impression that the Moon's limb could be traced a short distance from the Sun's disk at the upper and lower points of contact. The black surface of the Moon, when projected on the Sun's disk, appeared very uniform in colour, and darker than any of the spots.

Immediately after the last contact I tried with powers of 80 and 180, to distinguish the Moon's disk, but did not succeed. Light clouds were passing over the Sun and Moon at this time.

The diminution in light was quite perceptible at the time of the greatest phase. Telescope employed with $4\frac{1}{4}$ inches object-glass, with powers of 80 and 180.

Old Manor House, Ardwick, Manchester.

Solar Eclipse of December 21–22, *at Mr. Bishop's Observatory, Twickenham.* By W. Plummer.

The following times were observed with a power of 70 on the 7-inch Equatoreal as high a one as could be advantageously employed.

	h	m	s	
First contact, Dec. 21,	23	6	28·87	Twickenham M.T.
Last contact, Dec. 22,	1	40	32·72	„ „

The longitude of the Observatory is $1^m\ 13^s{\cdot}10$, west of Greenwich.

Observing with the comet-seeker, by Pistor and Martius, Berlin, Mr. Hind noted the first contact $0^s{\cdot}6$ later.

Solar Eclipse of December 22, 1870, *visible as a partial one at Armagh.* By the Rev. T. R. Robinson, D.D.

It was observed with a 7″ achromatic by Cauchoix, power 75, and the times were recorded by a chronograph of Krille.

	Armagh M.T. h	m	s
Beginning of Eclipse	10	33	53·43
First limb on first of two large spots ..	10	58	24·70
First limb on a spot high in field	11	2	26·44
First limb on second of two large spots ..	11	4	10·55
First limb on second of small group ..	11	32	30·18
Second limb on second of two large spots ..	11	59	56·29
Second limb on upper spot	12	18	30·62
End of Eclipse	1	3	37·55

Observatory, Armagh.

On the Solar Eclipse of the 22nd of December, 1870.

By Charles H. Weston, F.R.A.S., &c.

The day of the eclipse proved at my Observatory very unfavourable for critically examining its phenomena. The upper sky was marked by *cirri-strati*, resulting from a southerly current in high regions, while near the earth a strong north-easterly wind brought heavy *nimbi*, with the low temperature of 23° Fahr. in the shade. The consequence of the aerial strata thus differing abruptly both in specific gravity and moisture would necessarily be a bad definition for telescopic observations, and thus the appulse and advance of the Moon on the Sun's disc were disfigured with boiling undulations.

I had previously marked the groups of solar maculæ for further testing refrangibility at the lunar surface, and especially the behaviour of the large spots, both as to their vertical and horizontal contour during the passage of the line of darkness over them. But the great undulations rendered futile all such attempts and all endeavours to trace irregularity in the Moon's edge, or to watch the solar cusps. Amidst this general failure, however, I noticed one interesting apparition, viz., that the disk of the Moon overlapping the Sun was *not uniformly dark, but enlightened for some distance from its periphery coextensively with the arc of contact.*

As I wished to test the correctness of my vision, I begged my friend Captain De Blaquiere (who had kindly undertaken to register all meteorological details throughout the eclipse) to come to the telescope and give me his impressions, when I found my own opinion confirmed.*

I shall pass over the several accounts given in our *Monthly Notices* of former eclipses connected with a bright border adjacent, but *exterior* to the Moon's limb, and the mathematical discussions to which they led, because such would be foreign to my present subject, which concerns an enlightenment *within* the Moon's disk. I shall, therefore, refer first to the account of the annular eclipse of 1858 given by Mr. Stuart.† The observations on this occasion were made under somewhat similar circumstances to my own, and the writer states that "the light from the Sun was very distinctly seen *within* the edge, and slightly illuminating the dark body of the Moon for a short distance," and that his impression at the time was that "the solar light was inflected by a rare lunar atmosphere however doubtful." The same eclipse was also watched by Sir John Herschel,‡ and by Messrs. Dawes and Breen,§ and although with a clouded and broken sky, *yet under very favourable defining conditions;* and then the lunar disk did

* Telescope used on that day was the Newtonian Reflector, 9 inches diameter and 9 feet focal length.

† *Monthly Notices*, vol. xviii. pp. 193–4. ‡ Ibid. p. 211.

§ Ibid. pp. 188–206.

not contain any partial illumination, expressly so in the account of Sir John Herschel and Mr. Breen, and impliedly so in that of Mr. Dawes.

I have also referred to a description of the Solar Eclipse of 1836 by Admiral Smyth,* from which it would also appear that no partial illumination was then seen on the Moon, and although it is remarked that at first the lunar limb was somewhat tremulous, it yet soon became steady and *the definition pre-eminently fine*.

The suggestion cautiously thrown out by Mr. Stuart as to whether this lunar illumination resulted from the frangibility of a lunar atmosphere was *per se* a very natural one, but when considered in connexion with contemporary observations it cannot be deemed valid. The united testimony on that occasion of Sir John Herschel and Messrs. Dawes and Breen under such favourable circumstances has set at rest the question of any visible refrangibility, and, therefore, the rationale of the illumination of the lunar surface must be sought for in some other cause.

The next step was to learn what other Astronomers had noticed during the last solar eclipse. Sir John Herschel very obligingly replied to my questions, and I have his permission to state that he did not see any particular light on the Moon and that it seemed to be uniformly and absolutely black, and that certainly the Moon looked darker than the solar spots, *i.e.* their *average* illumination for the low magnifier used did not allow a sight of the nuclei.

The case, therefore, seems to stand thus:—When the definition is really good no such particular illumination of the Moon's disk seems to have been remarked; but when the definition is bad, and the Moon's edge boiling, then a greater or less amount of such illumination seems to have been observable.

Would not the inference consequently be that this apparition must rather be the result of the conditions of the atmospheric medium through which the celestial bodies were viewed than connected with the bodies themselves? Or does it not arise from "one of those strictly ocular nervous phenomena not properly subjective, but sensational," alluded to by the Astronomer Royal in his very valuable paper on the lunar luminous band?†

Ensleigh Observatory, Lansdowne, near Bath,
31st December, 1870.

Note on Oudemann's Theory of the Coronal Radiations.

By Richard A. Proctor, B.A. (Cambridge).

The papers read at the last meeting on the subject of the recent eclipse were so full of interest that it seemed desirable not

* *Celestial Cycle*, vol. i. pp. 140–2.
† *Monthly Notices*, vol. xxiv. p. 18.

to prolong a discussion which was raised respecting Oudemann's theory of the coronal beams. But as some of the results which the eclipse observers obtained would appear to be invalidated if certain points of Oudemann's theory were admitted, I venture briefly to note two objections of which the second at least seems decisive against those points.

Admitting with Oudemann the probability that the interplanetary spaces are occupied to distances from the Sun far exceeding the radius of the Earth's orbit, by matter capable of reflecting a certain proportion of light, it yet appears improbable that the whole quantity of such matter within a distance from the Earth equal to the radius of the Moon's orbit could reflect an appreciable quantity of light. It seems exceedingly unlikely that under such circumstances the sky towards the meridian at night would remain to all appearance dark, while yet, according to Oudemann's view, the sky towards the Moon's place during total eclipse would be appreciably illuminated. It is undoubtedly true, as pointed out by Professor Adams, that some substances (black cloth or velvet for instance) are rendered visible by rays falling obliquely, whereas rays falling square to their surface are absorbed. But certainly all the forms of non-luminous matter which we *know of* as tenanting the interplanetary spaces, would be better seen when placed as planets are when in opposition than as planets are when near inferior conjunction. I need not point out why this is, or that it is not so much a question of the reflective capacity of the particles themselves, as of the proportion of their illuminated surface which is turned towards the Earth. Certainly a group of minute meteors near the Moon's place when she is full would send us much more light than the same group near the Moon's place when she is new.

But, quite apart from this, there is an argument which appears to me to render Oudemann's reasoning altogether inadmissible. Assuming that the quantity of illuminated matter lying on *this* side of the Moon during total eclipse would *by itself* be appreciable, yet the much greater depth of the same matter lying beyond the Moon (and as well placed for the oblique illumination required) would be enormously greater, and would also be illuminated far more brightly. If a depth of 250,000 miles, full of such matter as Oudemann's theory requires, could give a certain quantity a of light, ten millions of miles next beyond and towards the same direction would undoubtedly give more than the quantity $40\,a$ of light, and the remaining 80 millions of miles lying yet further beyond, towards the neighbourhood of the Sun himself, would give a quantity of light which would even render this last-named quantity wholly inappreciable.

It is to be remembered that Oudemann's theory, or rather that special part of it which relates to the coronal beams, was urged to explain the supposed mobility of the beams, as seen by Dr. Gould; and that all the other American observers in 1869 considered that the beams were stationary. And further, it should be

noticed that a single observation of the fixity of coronal rays (as, for instance, Bruhn's observation in 1860) is more convincing than any number of observations of apparent motion. For, seen as the beams must needs be (if beyond our atmosphere) through a medium whose condition is probably very variable during a total eclipse, we can readily understand that their aspect should sometimes seem to vary, or even that they should appear and disappear under the observer's eyes. But the fixity of a coronal beam cannot so be explained away; and those who are familiar with the history of eclipse observations are aware that many of the positive observations of this sort are often unexceptionable.

Now the great V-shaped gap in the corona last December was visible at widely separated stations; it is clearly recognisable in a photograph taken by the American observers in Spain; and it remained unchanged during the whole of totality.* A positive observation like this, relating to an object extending to a great distance (nearly half a degree) from the Moon's limb seems altogether unmistakable in its import. When it is added that the bright inner corona was perceptibly depressed where this V-shaped gap existed, results of very great interest are suggested.

Do not the observations made last December strongly support the view urged a year ago by many (myself among the number) that the corona is a solar aurora? *If the action of the radial solar forces which generate this aurora be supposed only to be more energetic over the spot-zone, and specially over the regions where spots actually exist, we should not only have an explanation of the so often noticed trapezoidal form of the corona, but also a suggested explanation of the observed association between the Sun-spot period and terrestrial auroras.*

On the Nomenclature of Matter exterior to the Sun's Globe.
By Richard A. Proctor, B.A. (Cambridge).

I venture, while there is yet time, to urge the adoption of convenient and expressive names for the phenomena presented during solar eclipses.

The word *photosphere* serves a very useful purpose, and I do not know that any other could be devised which would be nearly so suitable. But to the names *chromosphere* and *leucosphere* there are grave objections.

In the first place, the relation between the prominences and the layer of coloured matter at a lower level is such as to render the

* Since this was written I have had the opportunity of examining the best of Mr. Brothers' photographs (taken at Syracuse). This view, No. 5 of his series, far surpassing all other pictures of the corona in interest and value, shows the V-shaped gap opposite the south-eastern quadrant in an unmistakable manner. Indeed the gap is the most striking feature in the photograph. This disposes of the question.

term *Sierra* employed by those who discovered the layer altogether more appropriate than such a word as Chromosphere. Secondly, the name Chromosphere implies that the coloured layer forms a spherical envelope, which the irregularity of its sufficiently well-defined outline shows not to be the case. Thirdly, the word is not properly formed, *Chromatosphere* being, I apprehend, the correct form.

The objections to the word *Leucosphere* are even greater.* Such a word could not possibly be employed in descriptive astronomy without explanatory notes. And further it can scarcely be considered appropriate. For λευκός means *white*, and σφαῖρα means sphere; but the inner corona, when seen under favourable conditions, has not appeared white, and certainly it is not spherical. Furthermore, grave doubts exist whether the implied distinction between the inner and outer parts of the corona is more than apparent. It may be added that in all other combinations of the kind—as *atmosphere*, *photosphere*, and so on—(*hemisphere* belongs to another class) the first word of the compound is a substantive. There seems a valid objection to a change of plan in this respect.

But the great objection against both *Leucosphere* and *Chromosphere* consists in the utter unfitness of either for the purposes of descriptive writing. In this respect they differ wholly from the word *Photosphere*, which refers to a relation not likely to enter into descriptive passages; but objects such as those for which the names Chromosphere and Leucosphere have been suggested require expressive names. I can see no reason why the fine word *Sierra* should not be restored to its place in our books of astronomy; nor why, if it shall appear that a real distinction exists between the brighter and fainter parts of the corona, the former should not be called (as already by Schellen and Secchi) the *corona* and the latter the *glory*. Or else Professor Airy's mode of describing them might well be adopted, and one called the *ring-formed corona*, the other the *radiated corona*.

A Solar Fog-bow. By R. C. Carrington.

On the morning of November 27, at five minutes to ten, I saw a curious bow formed in a mist, which was just rising; the Sun was shining brightly, and on the principle of our motto, "*Quicquid nitet notandum*," I took immediate note of it. It was the smallest bow I have seen, not more than twenty-five paces from where I stood, and it measured thirty-five paces from bow to bow. I stept a yard at a pace, very nearly. The colour was white, like a lunar bow. But what was more remarkable was the appearance of a

* It was, of ceurse, only in jest that at the last Meeting I compared the sound of the word to that of *lycosphere* (a wolf-sphere).

centre, in which I could see the reflection of my head, which moved as I moved. I remember having seen a centre before in a rainbow, which I witnessed near Cader Idris, in Wales, in July, 1847, in a splendid bow of two arches, but which I never mentioned before, having never heard of the like.

Note on the Change in the Colour of the Equatorial Belt of Jupiter. By John Browning, Esq.

Since the appearance of my last paper in the *Monthly Notices*, Professor Herschel has kindly written me a letter on the subject of the change in colour of *Jupiter*. Some brief extracts from this letter will, I think, be of interest. Professor Herschel says,—

"I see in a recent number of the *Monthly Notices* that you are raising very interesting questions about the appearance of *Jupiter's* belts, which may lead to very important results if it is found that the coloured and disturbed appearances of the belts are subject to periodical maxima and minima at about the same time as those of the spots on the Sun."

In a number of the *Student*, published just a year since, I wrote an article on the physical condition of *Jupiter*, from which I now give an extract:—

"Another suggestion may be made here,—Sunspots are known to be periodical, their maxima and minima being about eleven years apart. As Mr. Huggins some years ago (date unknown) observed the equatorial belt of *Jupiter* to be of the same ochreish yellow as it is now, there is good reason to suspect periodicity in this change. A period of maxima of sunspots is now approaching. Have these two phenomena any relationship to each other?"

The information I have so much desired to obtain, as to when a change in colour had previously been observed, and the exact appearance of the planet at the time, Professor Herschel has kindly furnished me with in his letter. I, therefore, again give Professor Herschel's words:—

"On a fine night in January, 1860, I turned Mr. Prichard's $6\frac{3}{4}$-inch Equatorial, by Cooke, for about half an hour on *Jupiter*. The planet was so well defined, and the details of the markings on the equatorial belt were so peculiar, that I made a sketch of them, noting at the same time the remarkable brown colour of the equatorial belt. One of the edges of the belt (I think the upper side in the instrument) was beaded or divided into egg-shaped masses, which must have been of brighter or lighter colour than the background of the belt, to have given them so much prominence."

On January 7, at 9 P.M., three days before I received Professor Herschel's letter, I made a careful coloured drawing of the

planet, and the description given by Professor Herschel of the appearance of the coloured belt in January, 1870, would apply exactly to the appearance of the belt in this drawing. I have brought the drawing for inspection, but it is so similar to the one which appears printed in colours in the last Number of the *Monthly Notices* that it will not be necessary to print this as well.

My principal object in communicating this Note is to request that any observers who have kept a record of the appearance of *Jupiter*, at a date previous to the year 1860, will look through their note-books, and if they can find a note of the equatorial belt appearing to be coloured previous to that date will communicate the same either to myself or to the Society.

Clapham, January 9th, 1871.

Ephemeris of the Satellites of Uranus. By A. Marth, Esq.

For 8^h Greenwich Mean Time.

	Ariel.		Umbriel.		Titania.		Oberon.	
	Pos.	Dist.	Pos.	Dist.	Pos.	Dist.	Pos.	Dist.
	°	″	°	″	°	″	°	″
Jan. 11	236	12	113	17	118	28	49	39
12	104	12	15	21	65	27	23	44
13	324	14	300	17	22	33	1	47
14	175	15	206	20	350	35	341	45
15	24	14	127	18	314	30	317	41
16	243	12	26	20	264	27	287	37
17	111	12	314	18	215	31	253	36
18	330	14	211	19	181	35	221	40
19	179	15	140	19	148	32	197	45
20	30	14	37	19	103	27	176	47
21	251	12	326	20	51	29	155	45
22	118	12	224	18	12	34	130	40
23	325	15	151	20	340	34	98	36
24	184	15	51	18	300	29	63	37
25	35	14	336	20	248	27	34	42
26	258	12	238	17	204	33	11	46
27	124	13	161	21	171	35	350	47
28	339	15	66	17	136	31	328	44
29	188	15	346	21	87	27	302	38
30	41	13	254	16	38	30	268	36
31	266	12	171	21	2	35	235	38

		Ariel.		Umbriel.		Titania.		Oberon.	
		Pos.	Dist.	Pos.	Dist.	Pos.	Dist.	Pos.	Dist.
		°	″	°	″	°	″	°	″
Feb.	1	131	13	81	16	329	33	207	43
	2	344	15	356	21	286	27	185	46
	3	193	15	270	16	233	29	165	46
	4	47	13	181	21	194	34	142	42
	5	273	12	98	16	161	34	113	37
	6	136	13	5	21	123	29	79	36
	7	348	15	286	11	71	27	47	39
	8	198	15	190	21	26	32	21	44
	9	54	13	113	17	353	35	359	47
	10	280	12	16	21	318	31	339	45
	11	142	14	301	18	270	27	314	41
	12	353	15	201	20	220	30	284	37
	13	202	14	127	18	184	35	250	37
	14	61	12	26	20	151	33	219	41
	15	288	12	314	19	109	28	195	45
	16	147	14	212	19	56	28	174	46
	17	357	15	140	19	16	33	152	44
	18	208	14	38	19	343	34	127	39
	19	68	12	326	20	305	29	95	36
	20	295	12	225	18	254	27	61	37
	21	152	14	151	20	209	32	32	42
	22	2	14	52	17	175	35	9	46
	23	213	14	336	20	140	31	348	46
	24	75	12	239	17	93	27	326	43
	25	301	13	162	21	43	30	299	38
	26	157	15	67	17	6	34	266	36
	27	6	15	347	21	333	33	233	38
	28	219	13	354	16	291	28	206	43
Mar.	1	82	12	171	21	239	28	183	46
	2	308	13	83	16	198	33	162	45
	3	162	15	356	21	165	34	139	42
	4	11	15	271	16	128	30	110	37
	5	225	13	181	21	78	27	77	36
	6	90	12	99	16	31	31	45	39
	7	314	13	6	21	256	34	19	44
	8	166	15	287	17	322	31	358	46
	9	16	14	191	20	276	27	336	44
	10	232	12	114	17	226	29	312	40
	11	98	12	16	20	188	34	282	36

	Ariel.		Umbriel.		Titania.		Oberon.	
	Pos.	Dist.	Pos.	Dist.	Pos.	Dist.	Pos.	Dist.
	°	″	°	″	°	″	°	″
Mar. 12	319	14	301	17	155	33	248	36
13	171	15	202	20	114	28	218	40
14	21	14	128	18	65	27	193	44
15	238	12	27	19	22	32	172	46
16	105	12	314	18	348	34	150	43
17	325	14	213	19	310	30	124	39
18	175	15	140	19	261	27	93	36
19	26	14	39	18	213	31	59	37
20	246	12	326	19	178	34	30	41
21	112	12	226	18	144	31	7	45
22	330	14	152	20	99	27	346	45
23	180	15	53	17	48	29	324	42
24	31	13	337	20	10	33	296	37
25	253	12	240	17	337	33	263	35
26	119	12	162	20	297	28	231	38
27	335	14	68	16	249	27	204	42
28	185	15	347	20	202	32	182	45
29	37	13	256	16	169	34	161	44
30	260	12	172	21	133	30	137	40
31	125	13	84	16	84	26	108	36
April 1	340	14	357	21	36	30	74	35
2	189	14	272	16	0	34	43	39
3	43	13	182	20	327	31	12	43
4	268	11	100	16	282	27	356	45
5	132	13	7	20	231	28	335	43
6	345	14	287	16	192	33	310	39
7	194	14	192	20	159	33	279	35
8	50	12	115	17	120	28	245	36
9	275	11	17	20	69	27	216	40
10	137	13	302	17	24	31	192	44
11	349	15	202	19	351	33	171	44
12	199	14	129	18	315	30	149	42
13	56	12	28	19	267	26	122	37
14	283	12	315	18	218	29	90	35
15	145	13	214	18	182	33	57	36
16	354	15	141	18	149	31	29	41
17	204	14	41	18	105	26	6	44
18	63	12	327	19	54	27	345	44
192	90	12	227	17	14	32	322	40
20	149	14	153	19	341	32	294	36

	Ariel. Pos.	Ariel. Dist.	Umbriel. Pos.	Umbriel. Dist.	Titania. Pos.	Titania. Dist.	Oberon. Pos.	Oberon. Dist.
	°	″	°	″	°	″	°	″
April 21	359	14	54	17	303	28	261	34
22	210	13	338	20	251	26	228	37
23	71	11	242	16	207	31	202	41
24	297	12	153	20	173	33	180	44
25	154	14	69	16	138	30	160	43
26	3	14	348	20	90	26	135	39
27	215	13	257	16	41	29	106	35
28	78	11	175	20	4	33	72	35
29	304	12	85	16	331	31	41	38
30	159	14	358	20	289	26	16	42
May 1	8	14	273	15	237	27	355	44

In the night of Jan. 8 *Uranus* passed close to the place in the heavens, where it appeared on the evening of Jan. 11, 1787, when the two bright satellites were discovered by Herschel. In the interval between the two nights *Oberon* has performed 2278 whole revolutions and *Titania* 3523.

Ferndene, Gateshead, Jan. 18th, 1871.

Summary of Sun-spot Observations made with the Kew Photo-Heliograph during the year 1870.

(*Communicated by Messrs. Warren De La Rue, B. Stewart, and B. Loewy.*)

Months.	Days of Observation.	Days without Spots.	Numbers given to the New Groups in the Catalogue of Sunspots.	Number of New Groups.
January	11	0	No. 1126 to No. 1142	17
February	12	0	,, 1143 ,, 1168	26
March	14	0	,, 1169 ,, 1199	31
April	22	0	,, 1200 ,, 1230	31
May	25	0	,, 1231 ,, 1270	40
June	19	0	,, 1271 ,, 1309	39
July	18	0	,, 1310 ,, 1345	36
August	25	0	,, 1346 ,, 1389	44
September	21	0	,, 1390 ,, 1420	31
October	18	0	,, 1421 ,, 1459	39
November	17	0	,, 1460 ,, 1491	32
December	11	0	,, 1492 ,, 1528	37
Total	213	0	No. 1126 to No. 1528	403

The year 1870 was characterised by an exuberance of solar energy which is without parallel since the beginning of systematic observations (*i. e.* since 1825). The number of observed groups far exceeds that of any previous year; and it appears also from a

cursory comparison with the maximum year's observations, as recorded by Hofrath Schwabe, that the magnitude of the different groups, as well as the average amount of spotted surface during any period of the year, is unprecedented. Since accurate measurements on the area covered by the spots are wanting for any time previous to the Kew Cycle, it is, of course, impossible to speak on this point with absolute certainty.

The latter half of the year shows an increase of no less than thirty-five groups as against the first half; it seems, consequently, not at all certain that the real maximum has been reached or passed.

A very remarkable feature of the groups observed during the year appears to be their extraordinary lifetime. Although the calculation of the heliographic positions is not yet completed, and therefore the most reliable basis for judging on the identity of groups on their return to the visible surface is still wanting, yet there can be no doubt from the observations, that an exceedingly large number of groups completed 3, 4, and even more revolutions, before finally collapsing. Whether this peculiarity in the behaviour of groups belongs to all maximum years,—whether the groups of minimum years are on the whole of a more ephemeral existence,—and further, in what manner the duration of any single group is connected with, or dependent on, its magnitude and the law of periodicity, are questions very forcibly suggested by the observations of the past year.

January 6th, 1871.

Further Notes on the Floor of Plato. By W. R. Birt, Esq.

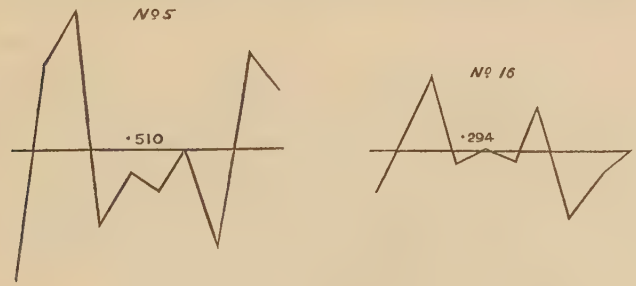
I have the honour to submit to the notice of the Society some further observations of the spots on the floor of *Plato*. In the *Monthly Notices* for April, 1870, vol. xxx., p. 160, will be found the normal degrees of visibility of the spots for twelve lunations ending March, 1870. The observations have been continued with the same care during the succeeding eight lunations, and now number 1594. The normal degrees of visibility have been determined for eighteen lunations; they are given in the following table:—

No.	Obs.	Vis.	No.	Obs.	Vis.
0	9	·046	9	43	·222
1	194	1·000	10	12	·062
2	9	·046	11	28	·144
3	174	·897	12	6	·031
4	173	·892	13	31	·160
5	99	·510	14	84	·433
6	43	·222	15	3	·015
7	22	·113	16	57	·294
8	3	·015	17	161	·830

No.	Obs.	Vis.	No.	Obs.	Vis.
18	14	·072	28	1	·005
19	29	·150	29	7	·036
20	9	·046	30	27	·139
21	5	·026	31	6	·031
22	34	·175	32	13	·067
23	9	·046	33	2	·010
24	11	·057	34	5	·026
25	28	·144	35	1	·005
26	1	·005	36	1	·005
27	2	·010			

In order to ascertain if the spots on the surface of *Plato* have been *equally* affected, which they should be upon the assumption of extraneous circumstances only producing changes in their appearance, such as solar illumination, alteration of position on the Moon's disk by libration and variations in the translucency and density of the Earth's atmosphere, the degrees of visibility for each pair of lunations between April 1869, and November, 1870, have been projected in curves. It is to the characters of these curves that I desire to solicit attention.

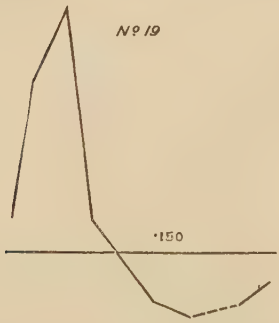
The general want of agreement which is found amongst the curves is at once conclusive that *all* the variations in visibility are not dependent upon the agencies above mentioned. On the other hand, the agreement subsisting between the curves of a few neighbouring spots points to some local agency, although in two instances spots at some distance from each other have manifested very similar phenomena, except in range; for example, spots No. 5

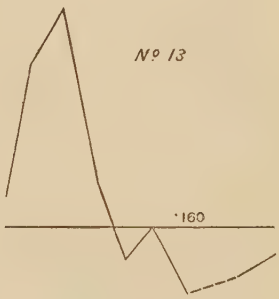


and 16; one not far from the south border, the other near the north border, have increased and decreased simultaneously during the eighteen lunations.

The curves are separable into three groups; the first distinguished by bold acuminated maxima, indicating a rapid increase of visibility and as rapid a decline, not unlike the maxima of some well-known variable stars which for a short time only are within the range of telescopic vision. Six spots, Nos. 19, 13, 22, 14, 5, and 16, on the western part of the floor, exhibited this rapid

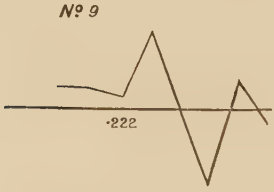
increase of visibility during August and September, 1869, in which spot No. 7 near the east border participated. The curves

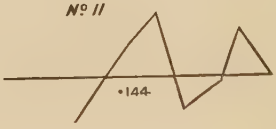




of Nos. 5, 16, 19, and 13 are given as specimens of those of the group.

The portion of the floor which may be regarded as the site of the second group is a band stretching from west to east on the southern half of *Plato*. Five spots, Nos. 9, 11, 18, 17, and 10 on





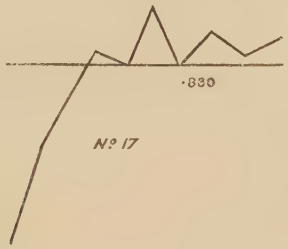
this band, with No. 29 near the north border, increased in visibility during February and March, 1870; the rise and fall being much less rapid than in August and September, 1869. The curves of Nos. 9 and 11 are given as specimens of this group.

In August and September, 1870, spots Nos. 18, 11, and 9, with the south-western spots 22, 14, and 5, and the eastern spots 6 and 7, increased in visibility, but not to the extent, except in No. 5, which characterised the increase at either of the previous epochs. These spots form the third group.

The above are not the only phenomena presented by the spots. In some cases we have nearly opposite curves, indicating opposite affections; for example, the curve of spot No. 19 on the north-west part of *Plato* is opposite in character to that of No. 17 on the south end. This is clearly apparent on comparing the curves. There appears also to be a general absence of agreement between the curves of those spots, as No. 17, which are known to be craterlets, as if the small white round spots differ from them specifically, or are affected by agencies that act more regularly. It is

to be remarked that the craterlets possess *high* degrees of visibility, *i.e.* they are much more frequently seen than the spots properly so called, which are mostly characterized by *low* degrees of visibility.

While these results appear to point to the operation of agencies the nature of which we are at present unacquainted with, they indicate the importance of continuing the observations, at least during another period of twenty lunations. It has already been



found that curves which in the earlier observations agreed in presenting similar maxima departed from a typical form in the latter, showing that the same spots were not under the same influences at the two periods.

It is not impossible that the prominent features of the curves may be explained upon the hypothesis of a present lunar activity. It is, however, desirable that observations should be multiplied, especially as there are strong objections to such a view, although the idea has been mooted during the last eighty years.

Solar Eclipse, June 22, 1870. By John Tebbutt, Jun., Esq.

The solar eclipse of last month was observed by me with the four-feet refractor and a power of about 30, as follows:—

		Windsor M.T. d h m s
Beginning ..	..	June 28 20 14 30
End ..	..	21 16 20

The Sun's limb boiled considerably, but both contacts, especially the last, were pretty well observed. Sun-spots were remarkably numerous.

Windsor, New South Wales,
1870, July 11th.

Occultation of β^3 *Tauri.* By J. Joynson, Esq.

9th November, 1870.

		h m s
Disappearance	..	11 19 11·3 G.M.T.
Reappearance	..	12 16 50·7

The above observation was very satisfactory. The star disappeared at the bright and reappeared at the dark limb of the Moon; and the times above given agreed very closely with a calculation made for this place with the aid of Prof. Chevallier's method, which gave for the

		h m
Disappearance	..	11 19·0
Reappearance	..	12 16·5

Lat. 53° 28′ 24″ N.
Lon. 0 12 7 W.

Waterloo, near Liverpool,
6th Dec. 1870.

Notice of a presumed new Variable Star in the Constellation of Orion. By the Rev. T. W. Webb.

On December 25, 1869, while sweeping over a part of the constellation of *Orion* with a power of 65 on my 9-inch silvered speculum by With, I came across a red star, which I then estimated of the 10th magnitude, and considered less deep than R *Leonis*, but still of a conspicuous colour, not unlike R *Crateris*.

Dec. 27.—I have noted that it was one of a triple group, the others being smaller, about 11 mag. of the Bedford Catalogue, and situated at position-angles roughly estimated at 230° and 340°.

Jan. 26, 1870, on looking for this object with a power of 110, I was at once struck with its increased brightness: it seemed much more strongly contrasted with its two companions, and I thought it nearly of 9 mag.; the colour I considered not greatly inferior to that of Hind's crimson star.

Jan. 27.—I have noted that the triplet is in the middle of a large triangle of stars, the brightest of which, a white 9 mag. star, nearly precedes it; the other two, at the *n f* and *s f* angles, being about 10 mag. The ruby star, approaching more nearly to the brightness of the first than of the others, might be rated about 9·3 mag. The accompanying rough eye-sketch may serve to give an idea of the configuration.

Feb. 25.—I did not think it any larger than on Jan. 26, but

the colour struck me as very fine. I also noted two minute points north of it.

March 5.—If it had changed at all, it might be rather smaller, the colour remaining as before.

Thus far the observations seemed to indicate a probability of variable light, as in the case of so many ruddy stars; but I was not strongly impressed by it, as I thought my earlier estimates of its magnitude might not have been made with sufficient care.

On looking for it again, however, on Dec. 23, 1870, very nearly twelve months after its first discovery, with the same power of 65 which I had most frequently used on former occasions, I found that no doubt remained as to this point. I could only see a group of three minute stars of nearly the same magnitude, all too small to show such a colour as was vividly impressed on my recollection: I noted in fact no difference of tint among them: but had it existed, the object would have been far too inconspicuous to attract attention, as it had done, in casual sweeping. The eye-piece was now slightly dewed; but the estimate, being a comparative one, was unaffected by this circumstance. As far as I could recollect the situation of the red star, I should have expected to have found it the central one of the three; but on subsequently comparing my former observations without attending to the estimated position-angles, I was so far misled by the mention, on Feb. 25, of "two minute points north of it," and in some degree, perhaps, by an idea that it might still be the brightest of the group, that I concluded that it must be the *s p* of the three little stars.

Dec. 24.—There being a good deal of haze, I considered that this *s p* star could not exceed 11 mag., and I noted that it was but a trifle brighter than its companions.

Dec. 26.—In thin haze; the same star was found to be very little brighter than the other two, and decidedly much inferior to the two stars at the *n f* and *s f* angles of the including triangle, which, supposing it to have been the red star, it surpassed on Jan. 27.

At last, on Dec. 29, notwithstanding a little fog, I was able to discover the error into which I had fallen. I had a very satisfactory view of the group with 65, and the distinct ruby hue which I perceived, and confirmed with an achromatic ocular of 212, convinced me that not the brighter *s p* star of the triplet, but the central one, was the object formerly observed: thus giving incidentally somewhat more weight to the evidence of variation. I repeated my guesses at the position-angles, and found them as on Dec. 27, 1869. The magnitude of the red star I now estimated at 11, that of the *s p* star 10·5, that of the remaining *n* star of the group 11·2: the *p* star of including triangle being considered 8, the *s f* 9·3, and the *n f* 9·5. Two minuter points, *n* and *f*, may have been about 13 mag.

I have only one further observation to add, that of Jan. 9, 1871, when I had an impression that the red star was slightly on

the increase, as its brightness was little, if at all, inferior to that of its *sp* companion. I was then also enabled to recover the second minute point north of it, which I had not noticed since Feb. 25, 1870, and which probably may not exceed 14 mag.

I have little confidence in my own estimates of absolute magnitude, but the star in question is so very favourably situated for comparison, that I have no misgiving as to the relative values that I have assigned to it; and these appear to me to establish in a very satisfactory manner the existence of variable light; leaving for future examination its amount, its period, and its epochs. All that can at present be inferred is that one *maximum* may probably have occurred in the spring of 1870; and that if now, as I suspect, on the increase, it must have subsequently passed a *minimum* stage. The range of variation hitherto observed may be assumed as extending through upwards of 1·5 magnitude of Admiral Smyth's scale.

Through the kindness of Mr. Knott, to whom I communicated my earlier suspicions of variability, I am informed that this star appears in Schmidt's Berlin Chart, and is marked in the accompanying catalogue as of 9 mag. the white star *p* being rated 8 mag. On Jan. 5, 1870, Mr. Knott estimated the magnitude of the variable star 9·5.

I have at present no means of giving its place with accuracy; but it is easily found about $6^m\ 18^s$ in time west of 42 *Orionis*, and nearly on the parallel of a minute open pair, about 11 mag. 9′ or 10′ north of that star.

Minor Planet (110).

The following elements, calculated by Herr Oppenheim from observations, Bilk and Leipsig, April 20; Berlin, May 3 and 20; are given, *Ast. Nach.* No. 1805:—

1870, April 22·5 Berlin (?) M.T.

M	=	193°	18′	54″·3
ω	=	300	17	16·5
Ω	=	59	9	58·6
i	=	5	52	11·9
ϕ	=	4	38	15·0
μ	=			803″·712
log a	=			0·429938

Minor Planet (111) *Ate.* Discovered 14th August by Dr. C. H. F. Peters.

The following elements, calculated by Dr. C. H. F. Peters, Clinton, N. Y. are given, *Ast. Nach.* No. 1822.

1870, Sept. 0·0, Berlin M.T.

$$
\begin{aligned}
M_0 &= 208^\circ\ 17'\ 21''\cdot0 \\
\pi &= 122\ 53\ 7\cdot3 \\
\Omega &= 306\ 26\ 28\cdot4 \quad \text{Mean Equinox } 1870\cdot0 \\
i &= 5\ 1\ 21\cdot4 \\
\varphi &= 5\ 49\ 10\cdot6 \\
\mu &= 858''\cdot392 \\
\log a &= 0\cdot4108808
\end{aligned}
$$

Comet II. 1870 (*Coggia's*).

The following system of elements, calculated from twenty-four observations up to the end of October, by Dr. Thiele, are given, *Ast. Nach.* No. 1826:—

$$
\begin{aligned}
T &= \text{Sept. } 2\cdot18382 \text{ G.M.T.} \\
\pi &= 7^\circ\ 52'\ 51''\cdot0 \\
\Omega &= 12\ 56\ 20\cdot3 \quad \text{Mean Equinox } 1870\cdot0 \\
i &= 99\ 20\ 34\cdot2 \\
\log q &= 0\cdot259275
\end{aligned}
$$

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